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ABSTRACT

The Vermont Institute for Science, Math and Technology (VISMT) was established in 1992 as a nonprofit organization to implement a $9.6 million dollar grant from the National Science Foundation (NSF) awarded to the Vermont Department of Education. The goal of the project is to dramatically transform science, math, and technology education for all Vermont students. This report reviews the first seven years of VISMT and assesses progress made in fulfilling the project's goal. (WRM)

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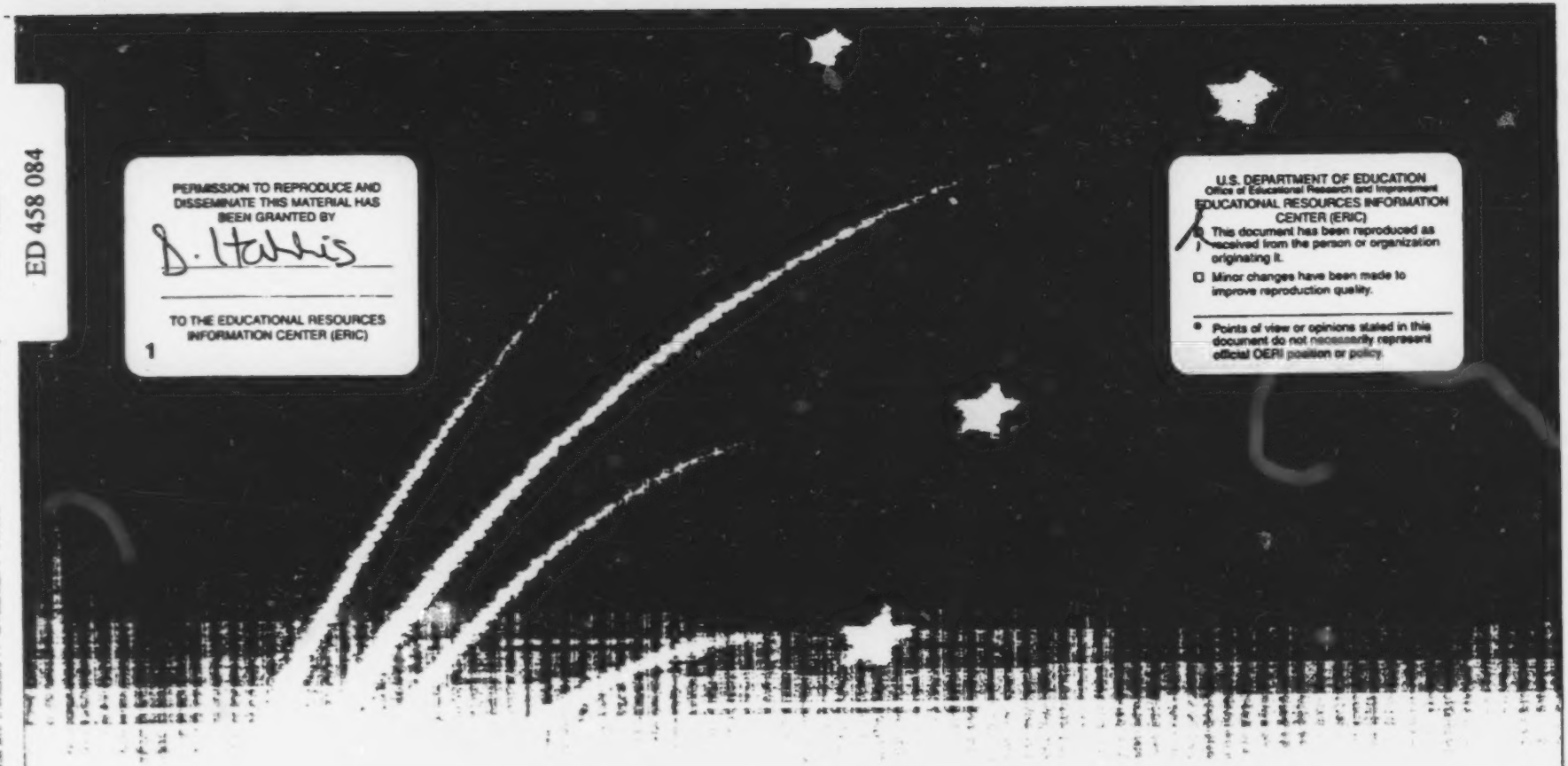

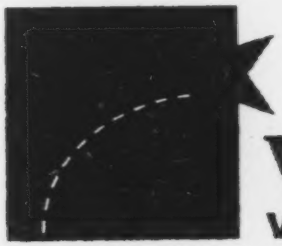

VISMT

VERMONT INSTITUTE FOR SCIENCE, MATH AND TECHNOLOGY

A Statewide Systemic Initiative

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The Vermont Institute for Science, Math and Technology was established in 1992 as a nonprofit organization to implement a $9.6 million National Science Foundation grant awarded to the Vermont Department of Education. A second continuation grant was awarded in 1998. The goal of the project is to dramatically transform science, math and technology education for all Vermont students.

Our thanks to all the students, teachers, parents, and communities who have joined us in this challenging journey toward high quality science, math and technology education. Thanks also to our many partners who appear in this publication. We are also grateful to the many businesses, foundations, and individuals who have supported our work with funds, equipment, and resources of every kind.

Credits
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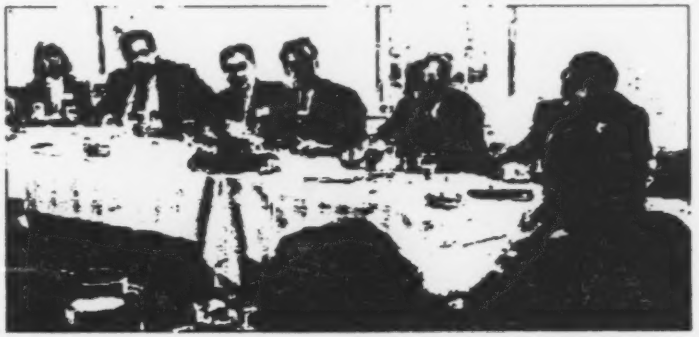
May 1999

VERMONT INSTITUTE FOR SCIENCE, MATH AND TECHNOLOGY



As hard as we work today, we know our real job is to make certain Vermont tomorrow is a place we would like our children and grandchildren to value, as we do. This requires hard work, providing the skills, knowledge, and goals that will assure a productive and gratifying life for each and every Vermonter. Only aggressive determination to change education today can promise us the educational quality and improvement that we must have in every school and every classroom, in order to achieve the possibilities of the future. VISMT has been at the front of the push for improved quality in science, math and technology education through most of this decade, and is one of the reasons we can look to a strong Vermont in the next century.

- Governor Howard Dean, MD

Vermont's efforts to improve the teaching of science, math and technology have had two indispensable allies — the National Science Foundation and the Vermont Institute for Science, Math and Technology. VISMT has been a major leader in standards-based reform in Vermont. Its efforts have helped focus public attention on the need for rigorous standards and linked assessments in science and mathematics. VISMT has paid attention to important and timely issues... equity, leadership, high quality staff development, and substantive technology support.... during a period of rapid change in education. VISMT's efforts have been a driving force behind the implementation of strategic school reform in Vermont.

- Commissioner of Education, Marc Hull

The future awaiting today's students is uncertain. What changes in the workplace can they expect? What new discoveries await them? What developments in science, math and technology will shape their daily lives? How can education today prepare them for tomorrow?

While life must be lived by looking ahead, it can only be understood by looking back. This report reviews the first seven years of VISMT and progress in fulfilling our mission of "dramatically increasing the science and math skills of all Vermont students to very high standards."

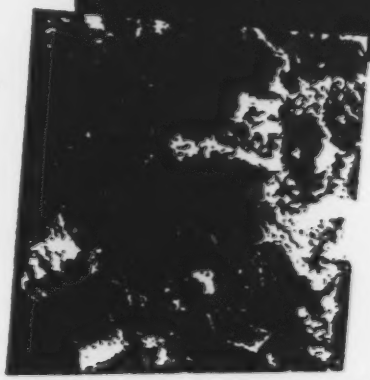
While our successes are many, there are still bridges to cross. In the future, as in the past, our success will depend on collaboration. We look forward to working with our partners in pre-K-12 schools, higher education, business, government and Vermont's communities, as we continue the important work of preparing our students for whatever science, math and technology hold in their future.

- Executive Director, Douglas Harris

Since 1992, VISMT has conducted **professional development programs** for teachers statewide, with inquiry-based science study, introductions to the standards, trainings in assessment and portfolio, and in-depth content study in science and math.

Students have been included in many professional development opportunities and often attend Vermont Fest, the annual technology fair. VISMT has sponsored technology competitions statewide and cosponsored science activities for students at all levels PreK-12. Two years ago, students began serving as regular members of the VISMT governing board.

The **Teacher Associates Program** was established by VISMT in 1994 and has become the "flagship" outreach and teacher leadership program for science and math in Vermont. Each year an increasing number of the highest quality SMT teachers have been selected to serve as peer mentors and trainers for the year; they continue a limited time commitment with their home schools, but serving as planners, advisors and demonstrators rather than classroom teachers. In 1998-99 VISMT regionalized the Associates Program to cut down travel and enhance the relationships Associates can build with schools and peers.



great wave of change in Vermont education began a decade ago, with a series of town-meeting-style discussions about the condition of education in our State. The Commissioner of Education traveled from town to town and talked with hundreds, and thousands, of Vermonters. The result was The Green Mountain Challenge: the beginning steps toward dramatically transformed educational goals for every school, every town and most importantly, for every student.

Out of that work, the drive began for improved science, math and technology education. It was the right idea at the right time, with the pace of science and math demands increasing drastically in business and every day life. Vermont was one of twenty-seven states to receive a Statewide Systemic Initiative grant from the National Science Foundation in 1992, and has been on a remarkable trajectory of change ever since. With the demands from our State, the continual reminders nationally, and the conceptual guidance provided by the NSF, Vermonters have moved toward high quality education for every child. This has demanded establishment of standards, greatly enhanced teacher development, partnerships with everyone involved with learners of any age, a new emphasis on collection of data and insistent assessment and accountability at every level.

By the time VISMT's second grant was awarded in 1998, this time one of only eight continuation grants nationally, the work had escalated and been refined. With the addition of Teacher Associates who expanded our ability to reach every teacher and every school, with the acceptance of Vermont's Framework of Standards and Learning Opportunities, with highly challenging assesament tools in science and math, with the capacity to collect and utilize the data they provided, with publication of materials designed to inform parents and community members, and with work on statewide equity policies, VISMT encouraged transformation of our education system.

The work continues and it evolves. Achieving each goal provides the viewpoint for the next challenge. In this report, we reflect on the progress to this point, not as a cumulative assessment, but to share the strength as we move forward. Our goal is high quality science, math and technology education for each student in Vermont, so each one can look to a productive and rewarding future.

HISTORY

A great wave of change in Vermont education began a decade ago, with a series of town-meeting-style discussions about the condition of education in our State. The Commissioner of Education traveled from town to town and talked with hundreds, and thousands, of Vermonters. The result was The Green Mountain Challenge: the beginning steps toward dramatically transformed educational goals for every school, every town and most importantly, for every student.

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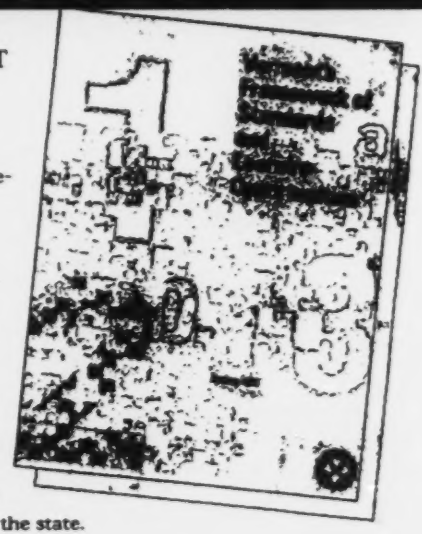
By the middle of 1999, 99% of Vermont schools had been engaged in VISMT programs

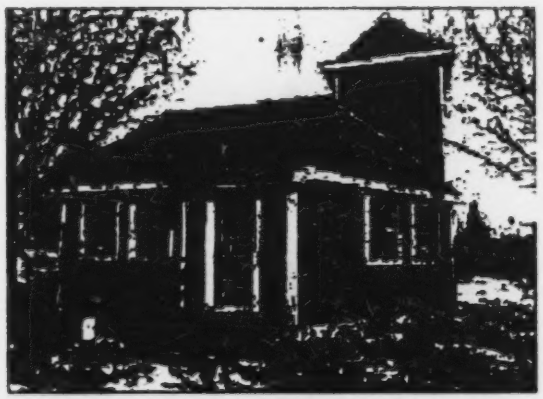
POLICIES

Governor Howard Dean has been an active partner with VISMT in promoting systemic reform.

Making major change in education requires the commitment, approval and imprint of many partners. In Vermont, major policy changes have signaled the formal acceptance of each step along the path to science and math education reform. Most notable is the Equal Education Opportunity Act of 1997 which totally revamped the funding system for public education in Vermont to provide equitable opportunities for every child in every town. VISMT aggressively supported the quality components of EEO.



The adoption of *Vermont's Framework of Standards and Learning Opportunities* is a crucial landmark in terms of learning. With its implementation, the levels of expectation have been raised for students, classrooms, schools, teachers and districts. In addition, policy enactments by the State Board of Education have enabled VISMT to move aggressively with reform in areas of science and math assessment, data gathering, teacher licensure. Even the simple act of reporting results publicly has marked a change in policy in Vermont, and has prodded continual improvement.



Small schools have historically made up a large percentage of Vermont's rural system, and have been beneficiaries of much policy reform.

Vermont has enjoyed the support of Governor Howard Dean, MD, Senators Patrick Leahy and James Jeffords, Congressman Bernard Sanders, and both houses of the state legislature in approving policies that assure high quality science and math education for every child in the state. Today, statewide partnerships are expanding these policies to include pre-kindergarten and post-high school education as well.

STANDARDS-BASED CURRICULUM AND LEARNING

When VISMT began, the need for standards was overwhelming but the path to developing and implementing such guidelines was a mystery. Over the intervening seven years the process has evolved. Today, *Vermont's Framework for Standards and Learning Opportunities* has been developed, published and approved by the state's Department of Education, and is being implemented in 100% of Vermont schools.

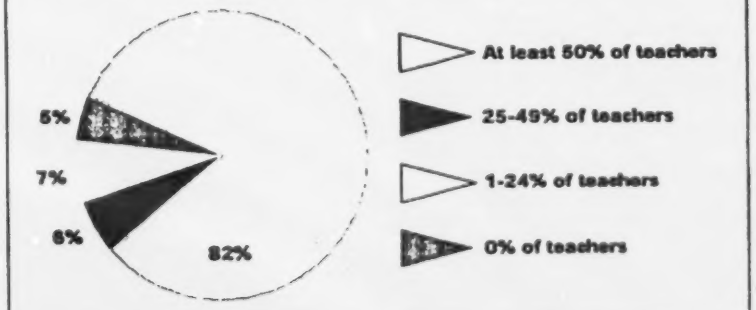
VISMT's curriculum work today is focused on assisting schools and teachers in selecting and implementing high quality standards-based materials. Efforts range from direct professional development with teachers to reviewing materials and publishing summary materials for schools considering implementation. The *VISMT Guide to Local Standards-Based Science Curricula*, developed by staff, Associates and teams of local teachers, outlines a complete cycle of curriculum planning and revision against the guidelines of *Vermont's Framework*, and is being used by all administrators statewide.

Standards-based curricula has been supported further through the state requirement that every school develop an Action Plan, as a result of the quality components of the 1997 Equal Education Opportunity Act (EEO). These plans are developed in science and math through the methodology promoted by VISMT in the past several years, with a focus on analysis of assessment results and design of curriculum interventions based on demonstrated need.

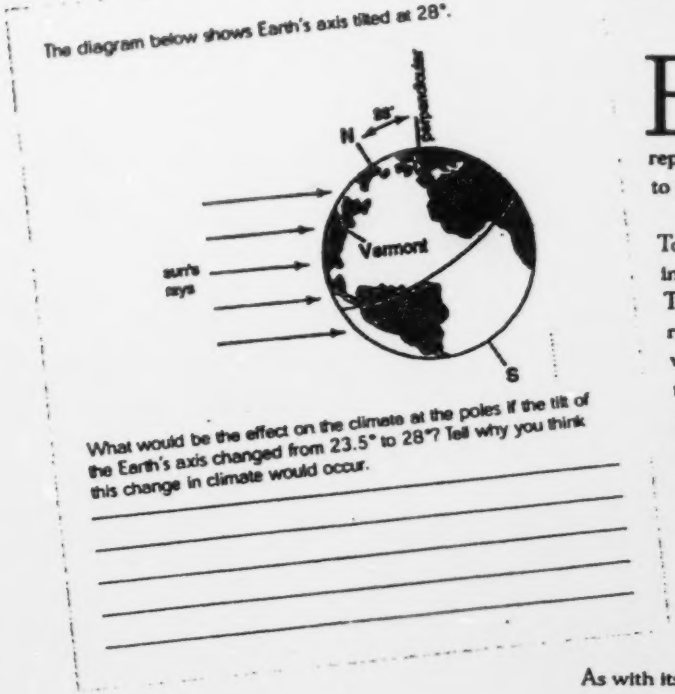
Early measurements show that schools using standards-based materials demonstrate greatest student improvement. Of fifteen schools showing the most improvement in science and math in VISMT's external evaluations last year, thirteen were utilizing recommended standards-based materials supported by professional development. While nearly two-thirds of the lowest performing schools were also utilizing standards-based materials, their teachers were receiving only six hours or less of professional development for implementation.

1999 Standards-Based Program Implementation

Percent of schools implementing math or science programs at different levels



ASSESSMENT


The diagram below shows Earth's axis tilted at 28°.
N
28°
perpendicular
Vermont
sun's rays
S
What would be the effect on the climate at the poles if the tilt of the Earth's axis changed from 23.5° to 28°? Tell why you think this change in climate would occur.

Early in the 1990's Vermont schools administered a variety of assessments haphazardly, with no agreement on goals or items to be tested. Student scores were obtained, with comparisons to national norms, but there was no coordinated student, classroom, school, district and statewide reporting. There was no sense that the results of assessments could actually drive teaching plans in order to target greatest areas of need.

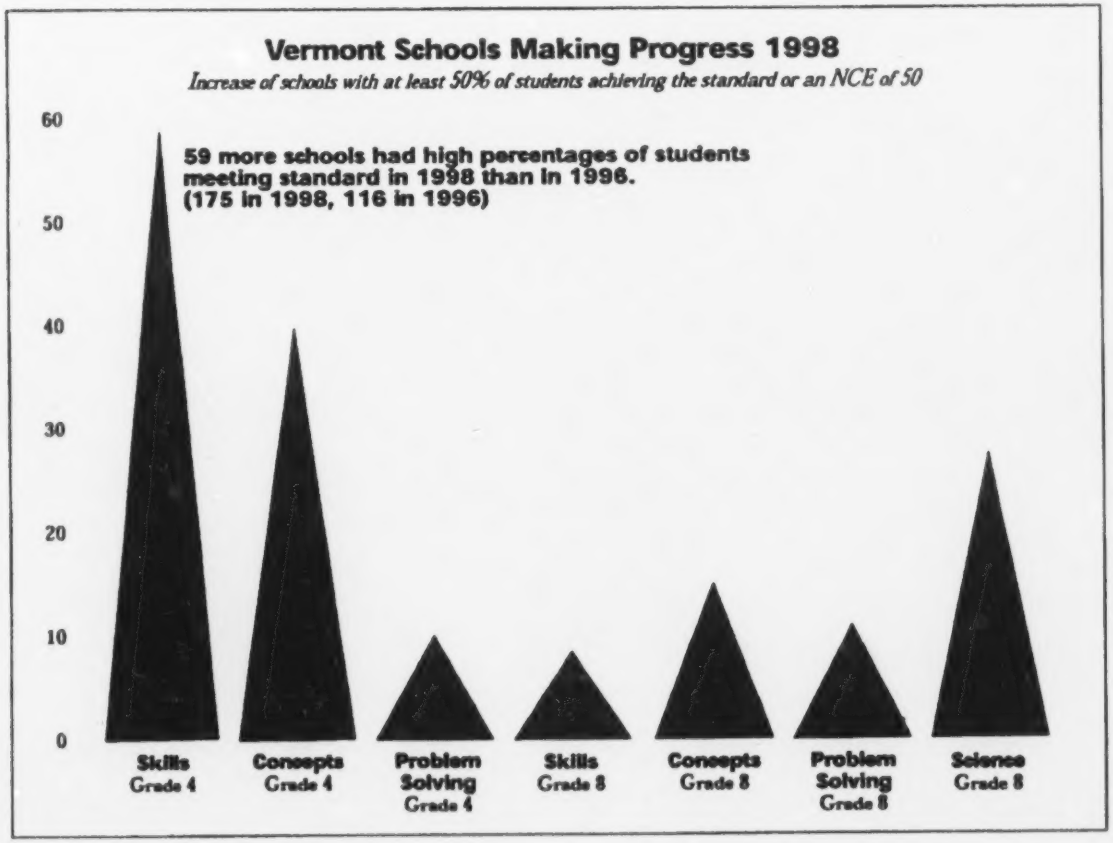
Today there are statewide science assessments at grades 6 and 11 and the New Standards Reference Exam in math is administered at grades 4, 8, and 10. Math portfolios are assessed at grades 4, 8, and 10. Through rigorous scorer training, reliability has been increased each year. Schools, teachers and parents receive the results, and school and state results are publicized. Teachers utilize the results to determine which areas of work and what thinking and learning skills should be emphasized. For instance, statewide testing has shown an extreme variation between math skills and problem solving ability. As a result, professional development in the area of teaching problem solving has been greatly enhanced, and a group of VISMT Associates developed a handbook for teachers which specifically targets problem-solving.

While Vermont's statewide assessments were among the first nationally, with pilots conducted in 1995, the annual revamp of these tests reflects national and international progress. Vermont's work on the standards and on assessment has considered the findings of TIMSS, NAEP and other national and international assessments. In addition, VISMT has worked with IBM's Reinventing Education grant to develop an outstanding electronic portfolio system for assessment.

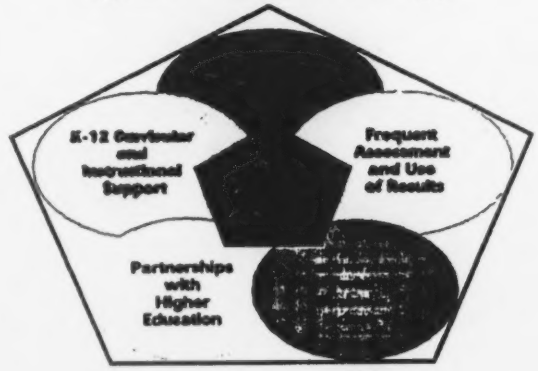
As with its other trailblazing work, Vermont has worked to communicate the reasons for change and the methods used through its booklets for parents and community members. Published in 1998, the booklet *Understanding Assessment in Vermont's Schools* demystified the programs and purposes of statewide testing.

Results are communicated through newspaper articles and supplements and the web pages of the Department of Education and VISMT (www.vismt.org).

Improvements are indicated in results since 1996. As seen in the chart illustrating the percent of schools with at least 50% of students meeting the standard in math, grade 4 concepts have jumped 18% and at grade 8 concepts jumped 12 points. Similar improvements are illustrated in skills and problem solving at both grade levels, though the margins in problem solving are smaller: thus, the focus on problem solving in professional development work and classroom planning. Other improvements illustrated on this page include a 14% gain in elementary science and 7-14% gains in elementary math.


Vermont Schools Making Progress 1998
Increase of schools with at least 50% of students achieving the standard or an NCE of 50
59 more schools had high percentages of students meeting standard in 1998 than in 1996. (175 in 1998, 116 in 1996)
60
50
40
30
20
10
0
Skills Grade 4
Concepts Grade 4
Problem Solving Grade 4
Skills Grade 8
Concepts Grade 8
Problem Solving Grade 8
Science Grade 8

VISMT's Systemic Reform Strategy


K-12 Curricular and Instructional Support
Frequent Assessment and Use of Results
Partnerships with Higher Education

Then

no statewide assessments
no statewide comparative results
no statewide information on performance
no training and planning based on results

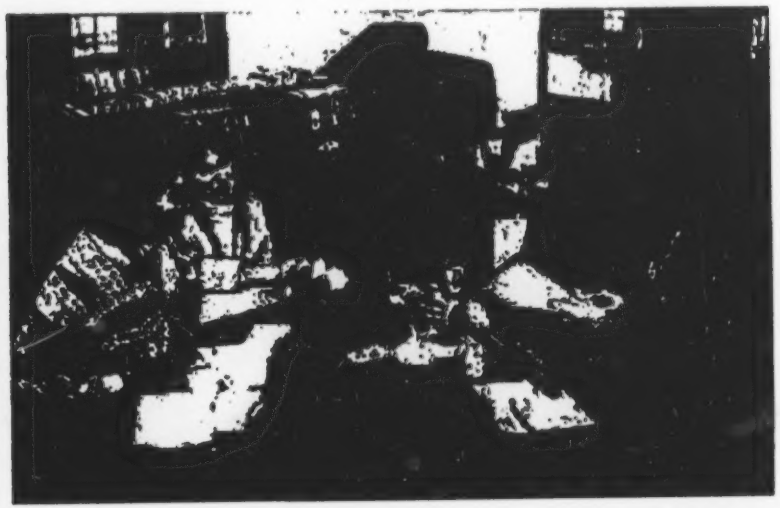
Now

Statewide math assessments
Statewide science assessments
Statewide performance results communicated
Action planning based on performance results

PROFESSIONAL DEVELOPMENT

Excellence in student learning is only possible with well-prepared, knowledgeable teachers. With this belief, VISMT has worked to develop a statewide science and math professional development system that assures quality teaching skills along with strong content knowledge. The progress on standards, assessment and licensure have all fed into professional development to clarify what teachers need to know, how they can continually improve, and how they can best meet student needs.

Partnerships with the University of Vermont, the State College System and private colleges, along with foundations and nonprofit educational organizations have enhanced VISMT's offerings. Today, summer institutes, in-service programs, and on-site interventions are augmented by the regional Teacher Associates Program which has set the pace for increased leadership through guided peer coaching. With just four Associates in 1995, VISMT now has 14 Teacher Associates, who are selected annually from exemplary classroom teachers and are given a year of leadership training in



Professional Development

Schools and teachers impacted by VISMT

Elementary		Middle		High School				
Schools	Teachers	Schools	Science & Math Teachers	Schools	Science & Math Teachers	Superintendents	Principals	Curriculum Coordinators
218 (88%)	1,444 (47%)	121 (95%)	209 (45%)	65 (100%)	202 (40%)	32 (39%)	188 (49%)	29 (50%)

conjunction with assignments mentoring peers in planning, teaching and program development.

VISMT Equity and Information Technology staff augment the professional development system, bringing understanding of these complex issues to classroom teachers. Also, assessment specialists, data analysts and loaned business people bring their viewpoints and skills to teachers. VISMT brings research-based educational concepts, such as Complex Instruction, to teachers who might otherwise feel isolated from reform trends, research findings and new developments in teaching. Working with scientists and mathematicians from higher education and business, VISMT is now developing science and math content programs to help teachers deepen their learning.

VISMT's Partnership has grown to include:

University of Vermont: Arts and Sciences, Engineering, and Education
Saint Michael's College
The Vermont State College System (five colleges)
Middlebury College
Bennington College
EPSCOR Program
Trinity College
Lake Champlain Basin Science Center
Ruberstein Ecosystem Science Laboratory
Vermont Academy of Science and Engineering
Bell Atlantic Corporation
IBM
Vermont Math Coalition
National Life Insurance Company
The Josephine Bay Paul and C. Michael Paul Foundation
The Windham Foundation
The Braitmayer Foundation
The CESAME Project at Northeastern University
The Cosmos Project
The Web Project
The Human Resources Investment Council
Vermont Principals Association
Vermont Department of Economic Development
The Snelling Center for Government
Vermont State and Local Chambers of Commerce
Vermont Learn to Earn
Vermont Adult Learning
Vermont School Boards Association
Vermont Interactive Television
Vermont Business Roundtable
Vermont Businesses for Social Responsibility
Karl Suss America, Inc.
Eisenhower Regional Alliance: TERC
Synergy Learning
Greater Burlington Industrial Council
KSV Communication
Vermont National Educators Association
Society of Women Engineers
Vermont Superintendents Association
The Jessie B. Cox Foundation
Vermont Science Teachers Association
Vermont Elementary Science Project

PARTNERSHIPS

Reform cannot happen through a single advocate. Over seven years the list and intensity of VISMT's partners has grown exponentially. Early supporters such as IBM and the State College System, are still working with VISMT for high quality science and math education for every child. Each year new partners join the work. By 1999, every school Pre-K through 12th grade has been involved in the effort; many of the private schools, educational nonprofits, cultural organizations, businesses, and parent and community groups are now part of the project.

The overwhelming support for high quality science and math education was strikingly evidenced this spring when partners interested in developing new professional development programs for aspiring, in-service, and leader teachers gathered to plan next steps collaboratively. Over thirty-five senior staff from colleges, the Department of Education, private schools, public schools, education nonprofits, and human services organizations worked together. This is a new day in education planning for Vermont.

VISMT takes local partnerships seriously. Community presentations on science and math education have been offered along with Parent and Community Guidebook series, four booklets funded by the Josephine Bay Paul and C. Michael Paul Foundation and now in their second editions. In many cases widespread change in teaching and learning has been possible through courageous implementations in early advocate schools.

Recognizing the importance of the whole community in education, several schools developed intergenerational projects with learning for all.

In one enterprising partnership, IBM Engineer Chuck Griffith became a "loaned" Teacher Associate for a year.

LEVERAGING RESOURCES

The support of the National Science Foundation has swept VISMT's work into prominence in Vermont, but this was enriched by matching grants and contributions of time, cash, facilities, professional assistance and materials in every school, classroom and town statewide. Vermonters far surpassed the required 1:1 match for NSF funds in the first five year grant.

Businesses and foundations have supplemented the NSF funds by providing targeted support for essential programs and products:

- the Windham Foundation supports a Mathematics professional development program for teachers each summer;
- the Paul Foundation provided funds for the entire Parent Community Booklet Series;
- IBM supported an early pilot computer laboratory grant for two school systems and followed that up with the $2 million Reinventing Schools grant which has created the Electronic Portfolio System;
- Bell Atlantic has consistently supported projects, most recently with an ingenious technology support project for needy schools;
- the Braitmayer Foundation has supported extensive training for Teacher Associates

Over the course of the past seven years, VISMT has become a clearing house for science and math education funding for schools and other entities in Vermont. It serves as partner, sponsor and collaborator in other related projects, all designed to improve the quality of education statewide, including the Web Project, the Technology Literacy Challenge program, the Virtual Professional Development School (PDS) project, and administration of E-rate funds.

As NSF support declines in the remaining years of this grant-funded project, other sources of assistance and partnership are sought and coming forward. Already, the IMPACT project through CESAME at Northeastern University is providing for additional teacher development, and the COSMOS grant will assist in enhanced evaluation and analysis of impact. A futures planning team of VISMT Staff and Board, joined by business, higher education and government representatives are developing a sustainable, self-supporting long-term plan which continues to rely on the generosity and commitment of many Vermonters.

Then

NSF was the only external funding support for VISMT

Now

Midway through the Completion Grant, VISMT has many other partners

Businesses and foundations support projects

VISMT and other Vermont organizations collaborate on grant requests and planning

Professional Development, Evaluation, Information Technology and Curriculum receive support

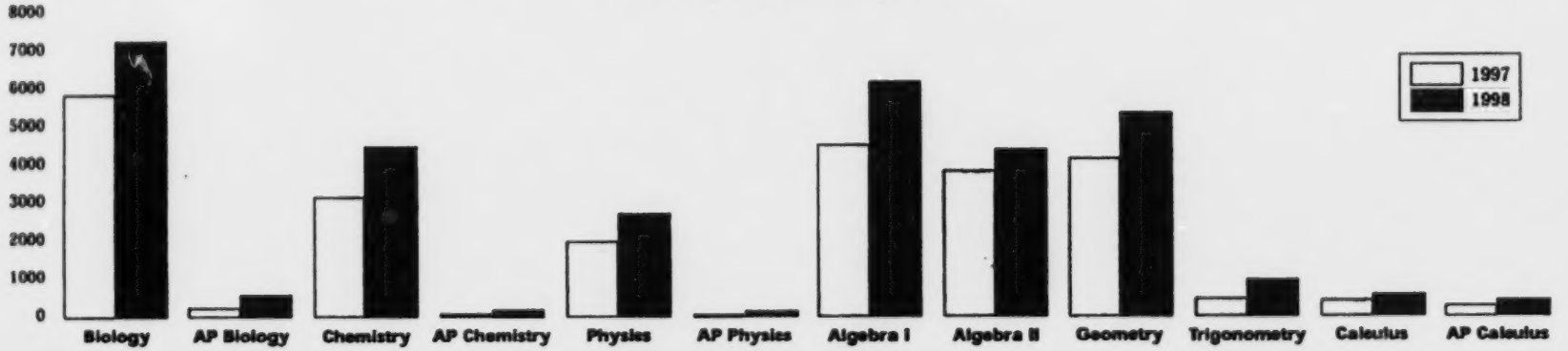
DATA COLLECTION AND ANALYSIS

At the outset, Vermont was truly a data-poor state. No statewide measurements existed for education issues, ranging from student performance to teacher preparation. Collaboration and correlation between school systems was not customary. In some school systems it was unusual for the elementary and secondary schools to coordinate their curriculum, due in great part to the lack of exchanged data. No measurements existed on comparative expenditures, on economic diversity and socioeconomic data, on student assessments, or on program improvements. This reality has been dramatically transformed.

Today all this data is collected, available, and publicly communicated on web sites and through reports to schools and communities. Importantly, it is useable data that forms the basis for Action Plans now required of every school in the state as part of the Equal Educational Opportunity Act. These data-based plans are the foundation for improving student performance in each school, just as student assessment results form the basis of curriculum emphases in classes. Similarly, VISMT has learned to gather data on its own impacts and utilize results to determine improvements in planning and outreach.

Vermont High School Course-Taking Patterns

Projected to 100% of high schools from reported data

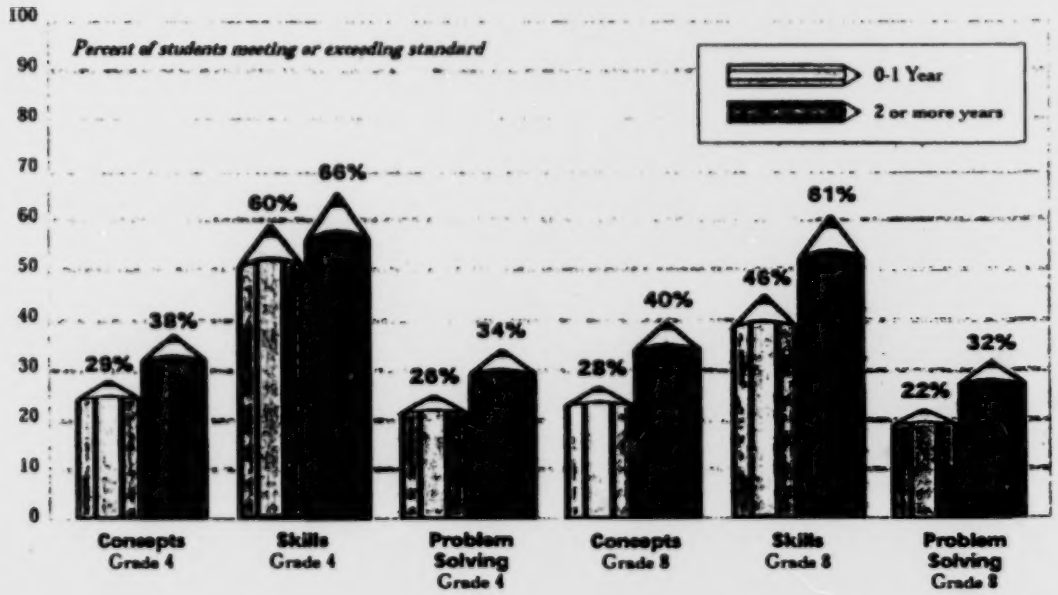


In Vermont, high school participation is increasing in every lab science, advanced math and advanced placement offering.

By gathering, analyzing and planning with data, Vermont teachers have gained the capacity to tailor their teaching to student needs; this combined with the Standards, which set expectations for content and performance, produces a substantive systemic approach to quality education.

1998 Mathematics Portfolio Analysis

Number of years maintaining portfolios versus student performance



In all cases, students using portfolios two or more years outperform their peers.

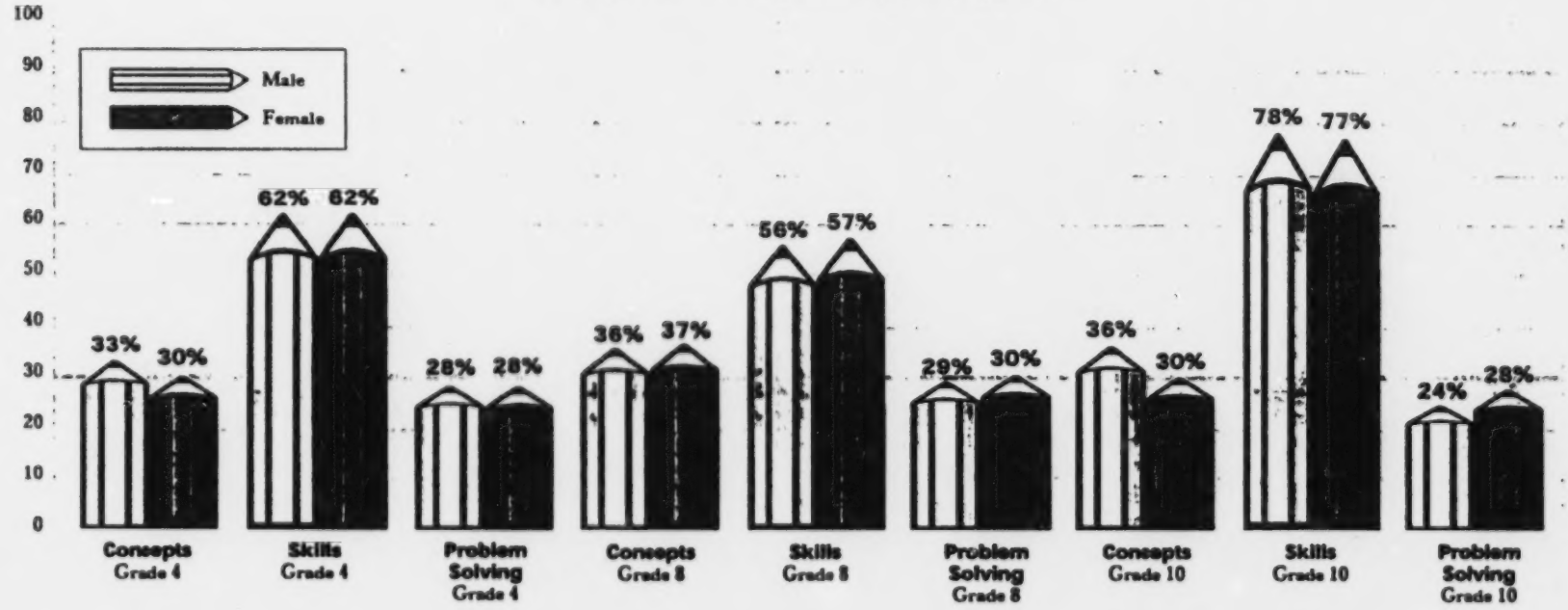
EQUITY

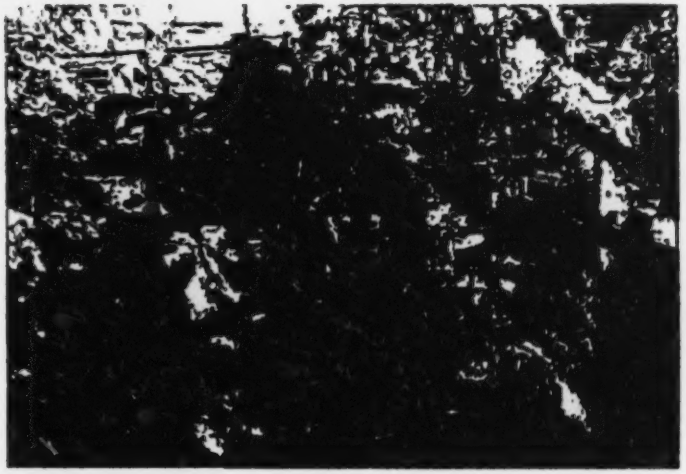
The landmark court case that led to the Equal Educational Opportunity Act in 1997 highlights the statewide concern for equity. The publicly prominent aspect of this Act was in the funding issues, however the quality of education was an equally important, far less publicized aspect. Although Vermont is technically the least racially diverse of all the states, there are serious equity issues that challenge our ability to provide high quality education.

For this reason, the infusion of equity awareness is a critical aspect of VISMT's work. Data has been effectively used in the examination of equity. While gender differences are far less severe in science and math in Vermont than other parts of the country (see charts), disaggregated data demonstrate the need for targeting other groups.

Equity in Vermont Mathematics, 1998

Percentages of students meeting or exceeding standard by gender

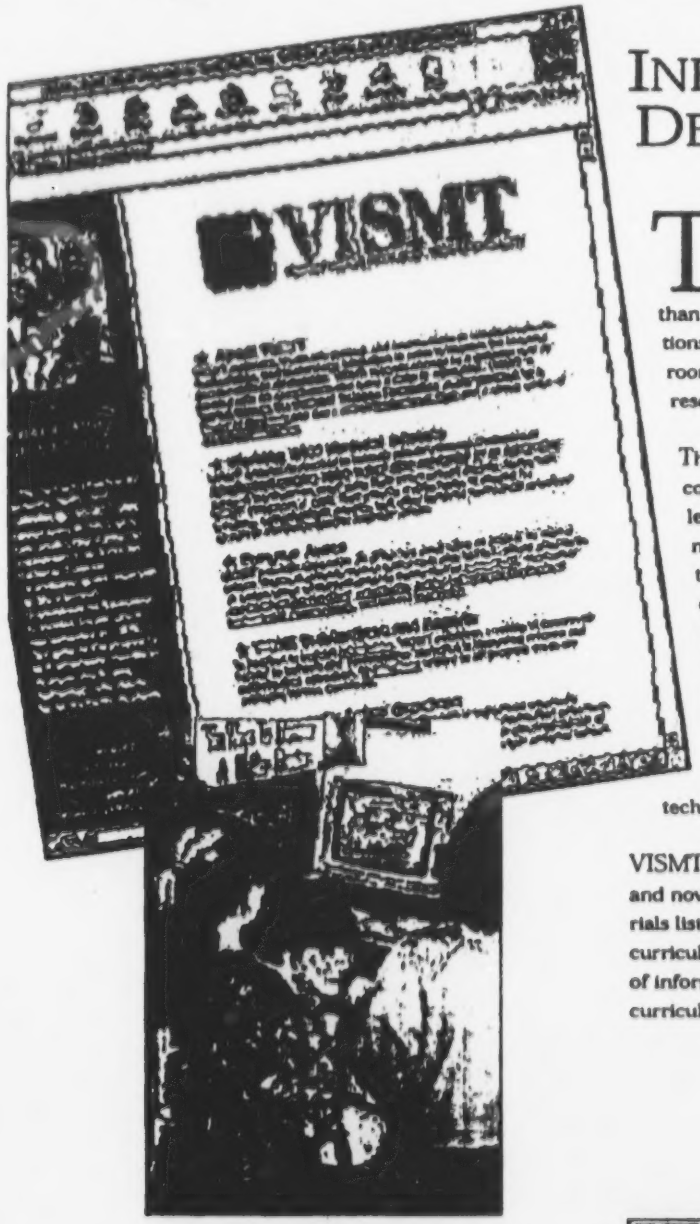




Socioeconomic factors, disability issues, geographic isolation, migrant status, limited English proficiency and special education needs all combine to create severe equity concerns. VISMT has committed itself to allaying these issues through highly trained teachers, school leaders, community members and parents. In the Teacher Associates Program and the Regional Equity Program, over 440 hours of training time are invested in the orientation phase to assure the ability of Associates to communicate equity skills and awareness to their peers.

In 1998-99, VISMT invested in training in Complex Instruction, an equity intervention particularly effective for the issues faced in Vermont. An initial group was trained, they carried their new skills back to the Associates and staff, and those individuals utilized and demonstrated the system regionally and systemically.

VISMT has also collaborated with Trinity College, Vermont Technical College, the Vermont Superintendents' Association, the Northern New England Tradeswomen, the Society of Women Engineers, and other groups to present programs on equity awareness and action.

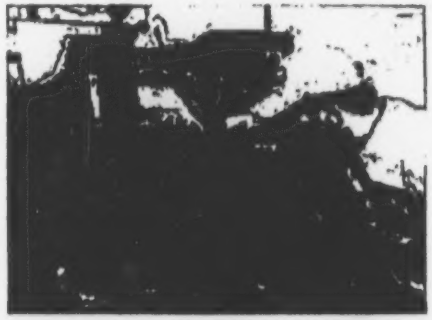


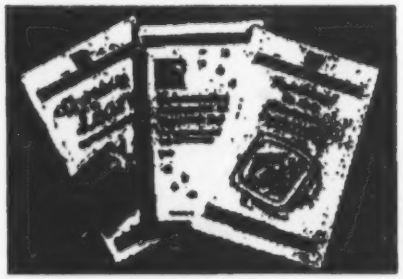
INFORMATION AND DESIGN TECHNOLOGY

The education world has changed significantly in terms of technology over the course of VISMT's lifetime. Vermont schools are no different. In 1992 few schools had more than a few computers and virtually none had Internet connections. Today students at nearly every school have regular classroom work integrated with technology, including Internet research and access.

The issue of obtaining computers became relatively simple compared to developing plans to use them. VISMT took the lead in developing and adopting a statewide information technology plan; it administers the Technology Literacy Challenge, the E-rate and Distance Learning programs. Currently 93% of Vermont schools have approved technology plans, the highest rate in the nation. Over 200 awards have been made in two years, with over $4.5 million dispersed. Professional development is an increasing service from VISMT, for current and pre-service teachers, in partnership with University of Vermont, VITA-Learn, and with Bell Atlantic through its innovative technology support awards.

VISMT has developed its website (www.vismt.org) and now posts all scheduling, publications and materials listings in addition to organizational data. The curriculum section alone includes over 1000 pages of information on the selection of standards-based curricula.

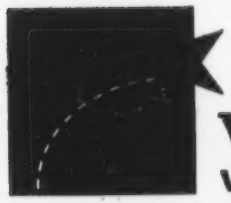




VISMT PUBLICATIONS

★ Equity Benchmarks for Vermont	1994
★ Grade Eight Guide to Diversity of Content and Problem Solving Tasks	1995
★ Getting Started With The Vermont High School Mathematics Portfolio	1995
★ Vermont High School Mathematics Portfolio Scoring Guide and Benchmarks	1995
★ When You Don't Know What to Do . . . Problem Solve!	1995
★ Television and cable series "My Future is Full of Science and Math!"	1996
★ Understanding Vermont's Framework of Standards and Learning Opportunities	1997
★ Understanding Assessment in Vermont's Schools	1998
★ Technology in the Classroom	1998
★ The Opportunity To Learn	1998
★ Vermont Science Assessment Blueprint	1998
★ Published Science, Mathematics, and Technology Programs that Fully Align with Vermont's Framework of Standards and Learning Opportunities	1998
★ A Guide for Local Standards-Based Science Curriculum	1998
★ Profile of a Comprehensive Mathematics Program	1999

"My future is full of science and math!" was the theme of a series of six PSA's VISMT developed and aired on television and cable.



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Opinions expressed are those of the authors and not necessarily those of the Foundation.